Chapter 14
Design Standards

14.1 General

This chapter defines the design standards that comply with the requirements of Title 23, USC Section 109(p) for Federal Highway Administration (FHWA) funded non-NHS public road projects on local streets and roads. The MDT Geometric Design Standards for Urban and Developed Areas have been adopted by local agencies and apply to all arterial streets and roads. These standards cannot provide for all situations, but are intended to define the minimum elements for assistance to competent design professionals, without limiting innovation or creative engineering.

For FHWA funded projects, these standards apply to all non-NHS streets and highways on federal functionally classified streets and roads except for rural minor collector and local access roads. These standards have also been accepted by the Montana Transportation Commission as the standards applicable to this funding program.

To be eligible for federal funding, pavement depth shall be designed to provide an extended service life of 8 years for structural deficiencies.

The included text and tables illustrate the minimum standards that apply to most of the design elements for FHWA funded projects. For other items of design, refer to the *MDT Road Design Manual* and the current version of the AASHTO Green Book.

14.2 Geometric Design Standards for Urban and Developed Areas

Appendix 14.31 is incorporated into this manual for use in construction of local roads and streets. The statutory city and county design standards committee has adopted these publications for use on all public roads, classified as collector arterial or higher throughout Montana. As updates are made by this committee, they will be included as an update to this manual.

14.3 Appendix

14.31 MDT Geometric Design Standards for Urban and Developed Areas

Appendix 14.31 MDT Geometric Design Standards for Urban and Developed Areas

MONTANA DEPARTMENT OF TRANSPORTATION
Geometric Design Standards for Urban and Developed Areas

INTRODUCTION

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) made sweeping changes to Montana's highway program. It placed an emphasis on better managing, maintaining and operating existing transportation systems and giving state and local governments the flexibility to meet their needs. This included environmental and social goals and objectives of communities as related to their transportation needs. The emphasis areas under ISTEA have been continued with the Transportation Efficiency Act for the 21st Century (TEA-21). On December 4, 1992, the Montana Transportation Commission approved the Montana Department of Transportation Highways Division's Geometric Design Standards. While these Geometric Design Standards established actual standards for the National Highway System, Primary and Secondary Highway Systems, they defaulted to full AASHTO standards to the extent economically feasible for streets/highways in urban and developed areas.

Full AASHTO standards are actually a range of criteria that allow transportation officials flexibility in addressing their transportation needs while considering environmental and social goals; however, the application of this flexibility has sometimes been an area of conflict between MDT and local officials. Through a collaborative effort, representatives from major urban areas in Montana and MDT staff developed a set of minimum criteria that shall be applied on all on-system streets and highways in urban and developed areas, except for routes on the National Highway System. These criteria are contained in this document as Montana Department of Transportation Geometric Design Standards for Urban and Developed Areas (Table 1 - Urban Standards) and replace the Highway Design Standards*for Urban and Developed Areas section of MDT's Geometric Design Standards. In those situations where adjacent development, other physical features or environmental features or factors limit the standards to which a facility can be constructed, exceptions to standards must be approved to deviate to lesser design criteria. In design practice, these Urban Standards must be supplemented with criteria from the AASHTO "Policy on Geometric Design of Highways and Streets", current edition, for those elements of design not included herein and for those transitional or undeveloped areas based upon their existing operating conditions.

DEFINITIONS

Clear Zone. The clear zone is an area unencumbered by obstacles starting at the edge of a travel lane that is available for the safe use and recovery of errant vehicles.

Clear Area. The clear area is the area extending 2 feet behind the curb that must be free of all obstacles.

Design Vehicle. The design vehicle is a vehicle with the dimensions and operating characteristics used to establish design controls for accommodating vehicles of designated classes. It should be the largest type vehicle commonly served by the route and the adjacent land use.

Functional Classification. Functional Classification is the grouping of roadways according to the character of service they are intended to provide. Ideally the classification provides the optimum balance between access and mobility for a highway system. The roadway classifications referred to in these standards are the Federal Functional Classifications shown on the official functional class maps prepared by the MDT Rail, Transit and Planning Division and approved by the Montana Transportation Commission and the Federal Highway Administration.

On-system. Any route of the National Highway System (including Interstate), or Primary, Secondary or Urban Highway Systems.

Transitional Area. Transitional areas provide connections between urban and rural areas. Running speeds in excess of 40 mph are typically found on these roadway segments.

Urban Area. An urbanized area or urban place as designated by the Bureau of Census having a population of 5,000 or more, within boundaries to be fixed by responsible State and local officials in cooperation with each other, subject to approval by the US Secretary of Transportation. Such boundaries shall encompass, at a minimum, the entire urban place designated by the Bureau of Census.

Urbanized Area. An area with a population of 50,000 or more designated by the Bureau of Census, within boundaries to be fixed by responsible State and local officials in cooperation with each other, subject to approval by the US Secretary of Transportation. Such boundaries shall encompass, at a minimum, the entire urbanized area within a State as designated by the Bureau of Census.

TABLE 1 – URBAN STANDARDS (METRIC)

Design *Standards* Metric	**Arterial** [a]				***Collector*** [a]
	Principal [a]		**Minor** [a]		
	(b)	(c)	(b)	(c)	(d)
Design Speed (km/h)	70	70	60	60	50
Intersection Sight Distance	Refer to AASHTO's A Policy on Geometric Design of Highways and Streets (Green book)				
(e) Stopping Sight Distance (m)	95	95	80	80	65
Minimum Roadway Width (m)	8.4	10.8	9	7.8	7.2
Exterior Lane Width (m)	3.6 [f]	3.6	3.3 [f]	3.3	3.0 [g]
Interior Thru Lane Width (m)	3.3	3.3	3.3	3.3	3.0 [g]
2-Way Left Turn Lane (m)	3.6	3.6	3.3	3.3	3.3
Exclusive Turn Lane Width (m) Flush Median	3.6	3.6	3.3	3.3	3.0 [g]
Parking Lane Width (m) [h]	3.0 [i]		3.0 [i]		2.4
Minimum Shoulder Width (m)	0	1.8	0	1.2	1.2 [j]
Minimum Raised Median Width (m) [k]	1.2	1.2	1.2	1.2	1.2
Ditch Slope	Slopes steeper than 4:1 should be used only when achieving a 4:1 slope is impractical				
Bicycle Lane	1.2 m [l]				
Right-of-Way	Not less than required for all design elements				
Clear Zone	Refer to the AASHTO Roadside Design Guide as a guideline				
Landscaping	Landscaping will be included as an element to be considered in the design of all urban streets				

These standards are to be used on routes within the urban and urbanized limits of major communities and within the city limits of communities which do not meet the criteria for urban areas. These design standards do not apply to routes on the National Highway System.

(a) Federal functional classification defined by MDT and approved by the Montana Transportation Commission and FHWA

(b) Curbed

(c) Shouldered

(d) Includes both curbed and shouldered cross sections

(e) The stopping sight distance must be adjusted for higher design speeds and grades. Refer to the AASHTO Green book.

(f) The lane width does not include the gutter section. Add one meter where wide curb lane is provided for accommodating bicycles.

(g) Use 3.3 meters for collectors that primarily serve commercial/industrial areas.

(h) Includes the width of the gutter section.

(i) 2.4 meters may be acceptable when the lane is not likely to become a traffic lane in the foreseeable future.

(j) Shouldered cross section only.

(k) The raised median width needs to be added to the exclusive left-turn lane width.

(l) The bike lane width can include the shoulder width if there is no parking. A 1.5 meter width is recommended from the face of curb, guardrail or other roadside barriers. An increased lane width is recommended where the percentage of trucks or buses is high. See the AASHTO Guide for the Development of Bicycle Facilities for additional information.

New Sidewalks	Minimum Width [(a)]	1530 mm (for Passage) 920 mm (minimum continuous clear width)
	Cross Slopes	1:50 (maximum)
	Gradient [(b)]	5% (maximum)
	Buffer [(c)]	0.5 m

a) The clear width is exclusive of the curb width. Where it is impractical to provide the minimum clear width of1530 millimeters, provide a minimum 920 milllimeter clear width and 1530 millimeter by 1530 millimeter clear passing spaces at 61-meter minimum intervals.

(b) The sidewalk gradient should typically follow the roadway gradient. Where the roadway gradient exceeds 5%, a maximum sidewalk gradient of 5% should be maintained unless it is impractical to do so.

(c) Where there is a drop-off next to the sidewalk that could pose a fall hazard (ditches, embankments steeper than 1:3), provide a 0.5-meter buffer between the edge of the sidewalk and the hazard.

Roadway Geometrics

The following items provide some basic references for design elements not included in Table 1. The designer should read the text associated with the referenced tables and should consider other related text and tables in the AASHTO policy. All of the referenced tables are from AASHTO's *A Policy on Geometric Design of Highways and Streets* (1994 edition - metric;).

Horizontal Curves. For speeds less than or equal to 70 km/h use Table III-7, $e_{max} = 4.0\%$ (pg 167). For speeds greater than 70 km/h use Table III-9, $e_{max} = 8.0\%$ (pg 169**).**

Vertical Sag Curves. Use Table III-37, (pg 292), "Design controls for sag vertical curves". The table is based on stopping sight distance.

Vertical Crest Curves. Use Table III-35, (pg 284), "Design controls for crest vertical curves". The table is based on stopping sight distance.

Vertical Grade. Use Table VI-3, (pg 463), "Maximum Grades" for rural and urban collectors up to a 10% maximum grade.

Intersection Design. The design vehicle must be identified based upon the functional intent of the intersecting roadways. If the passage is from arterial to arterial then the WB-19, tractor semi-trailer unit should be used. If the passage is from arterial to collector the design vehicle associated with the collector route should be used. If the passage involves a local road approach then largest vehicle typically accessing the local road should be the control. In all cases the passage should be made from the near lane directly into a departure lane on the downstream approach. The design vehicle shall not encroach on an opposing traffic lane.

TABLE 1 – URBAN STANDARDS (ENGLISH)

Design ***Standards***	**Arterial** [a]				***Collector*** [a]
	Principal [a]		**Minor** [a]		
	(b)	(c)	(b)	(c)	(d)
Design Speed (mph)	40	40	35	35	30
Intersection Sight Distance	Refer to AASHTO's A Policy on Geometric Design of Highways and Streets (Green book)				
(e) Stopping Sight Distance (ft)	305	305	250	250	200
Minimum Roadway Width (ft)	28	36	26	30	24
Exterior Lane Width (ft)	12 [f]	12	11 [f]	11	10 [g]
Interior Thru Lane Width (ft)	11	11	11	11	10 [g]
2-Way Left Turn Lane (ft)	12	12	11	11	11
Exclusive Turn Lane Width (ft) Flush Median	12	12	11	11	10 [g]
Parking Lane Width (ft) [h]	10 [i]		10 [i]		8
Minimum Shoulder Width (ft)	0	6	0	4	4 [j]
Minimum Raised Median Width (ft) [k]	4	4	4	4	4
Ditch Slope	Slopes steeper than 4:1 should be used only when achieving a 4:1 slope is impractical				
Bicycle Lane	4 ft [l]				
Right-of-Way	Not less than required for all design elements				
Clear Zone	Refer to the AASHTO Roadside Design Guide as a guideline				
Landscaping	Landscaping will be included as an element to be considered in the design of all urban streets				

These standards are to be used on routes within the urban and urbanized limits of major communities and within the city limits of communities which do not meet the criteria for urban areas. These design standards do not apply to routes on the National Highway System.

(a) Federal functional classification defined by MDT and approved by the Montana Transportation Commission and FHWA

(b) Curbed

(c) Shouldered

(d) Includes both curbed and shouldered cross sections

(e) The stopping sight distance must be adjusted for higher design speeds and grades. Refer to the AASHTO Green book.

(f) The lane width does not include the gutter section. Add three feet where wide curb lane is provided for accommodating bicycles.

(g) Use 11 feet for collectors that primarily serve commercial/industrial areas.

(h) Includes the width of the gutter section.

(i) 8 feet may be acceptable when the lane is not likely to become a traffic lane in the foreseeable future.

(j) Shouldered cross section only.

(k) The raised median width needs to be added to the exclusive left-turn lane width.

(l) The bike lane width can include the shoulder width if there is no parking. A 5-foot width is recommended from the face of curb, guardrail or other roadside barriers. An increased lane width is recommended where the percentage of trucks or buses is high. See the AASHTO Guide for the Development of Bicycle Facilities for additional information.

New Sidewalks	Minimum Width [(a)]	60” (for Passage) 36” (minimum continuous clear width)
	Cross Slopes	1:50 (maximum)
	Gradient [(b)]	5% (maximum)
	Buffer [(c)]	18”

a) The clear width is exclusive of the curb width. Where it is impractical to provide the minimum clear width of 60 inches, provide a minimum 36-inch clear width and 60 inch by 60 inch clear passing spaces at 200-foot minimum intervals.

(b) The sidewalk gradient should typically follow the roadway gradient. Where the roadway gradient exceeds 5%, a maximum sidewalk gradient of 5% should be maintained unless it is impractical to do so.

(c) Where there is a drop-off next to the sidewalk that could pose a fall hazard (ditches, embankments steeper than 1:3), provide an 18-inch buffer between the edge of the sidewalk and the hazard.

ROADWAY GEOMETRICS

The following provides some basic references for design elements not included in Table 1. The designer should read the text associated with the referenced tables and should consider other related text and tables in the AASHTO policy. All of the referenced tables are from AASHTO's *A Policy on Geometric Design of Highways and Streets* (2004 edition).

Horizontal Curves. For design speeds less than or equal to 40 mph use Exhibit 3-25, $e_{max} = 4.0\%$ (pg 167). For design speeds greater than 40 mph use Exhibit 3-27, $e_{max} = 8.0\%$ (pg 169).

Vertical Sag Curves. Use Exhibit 3-75 (pg 277), "Design controls for sag vertical curves". The table is based on stopping sight distance**.**

Vertical Crest Curves. Use Exhibit 3-72 (pg 272), "Design controls for crest vertical curves". The table is based on stopping sight distance.

Vertical Grade. Use Exhibit 6-8(pg 432), "Maximum Grades" for rural and urban collectors up to a 10% maximum grade. Use Exhibit 7-10 (pg 472), Maximum Grades for Urban Arterials

Intersection Design. The design vehicle must be identified based upon the functional intent of the intersecting roadways. If the passage is from arterial to arterial then the C–70, tractor semi-trailer unit should be used. If the passage is from arterial to collector the design vehicle associated with the collector route should be used. If the passage involves a local road approach then largest vehicle typically accessing the local road should be the control. In all cases the passage should be made from the near lane directly into a departure lane on the downstream approach. The design vehicle shall not encroach on an opposing traffic lane.